

ECOLOGY AND REPRODUCTION OF RED-SHOULDERED HAWKS IN THE WATERLOO REGION, SOUTHERN ONTARIO

by

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Abstract

A study of *Buteo lineatus* was done in 1973 for the Canadian Wildlife Service in south-central Ontario. Six pairs were studied in the Waterloo Region for habitat requirements, behavior (especially breeding and feeding), interspecific competition, and reproductive success. In 1973 two (and perhaps three) pairs raised young, two deserted, and two outcomes were not definitely known. Other aspects of reproductive history were deduced from past notes and Ontario Nest Record Cards for the Waterloo Region and surrounding counties. A decline in nesting numbers was noted over a period of 10 years. Loss of habitat and prey, and increasing raptorial competition, seem to be causing a decline in this species. Three eggs were analyzed for residues of organochlorines and mercury. Eggshell thicknesses were also recorded. Thickness index was calculated for 70 eggshells from this area. A 14.5 percent decrease in eggshell thickness has occurred since 1947.

Introduction

Five races of Red-shouldered Hawks (*Buteo lineatus*) range extensively through temperate and subtropical North America. The northern subspecies (*B. l. lineatus*) has a wide breeding distribution in the hardwood and mixed forests of the Upper Austral/Carolinian-Transition/Alleghenian zones, barely onto the Canadian Shield. It was one of the most common raptors throughout this range. Southern Ontario is the principal Canadian nesting grounds of this subspecies; the lower Great Lakes mark the northern limit of its regular winter distribution.

Study Area and Methods

The Waterloo Region, in the center of southwestern Ontario, with its numerous well-watered valleys, rapid rate of urbanization, and high level of agriculture has long had a concentration of nesting Red-shouldered Hawks, despite a pronounced decline since the 1960s. Since 1953 I have observed nesting of this buteo in the Waterloo Region. During 1973 I studied six pairs as a pilot project for the Canadian Wildlife Service (CWS). The Red-shouldered Hawk has seldom been studied intensively except in Massachusetts (Kennard 1894), Maryland (Stewart, 1949; Henny et al., 1973), and Michigan (Craighead and Craighead, 1956). Henny (1972) gave a brief summary of its population dynamics, and Bent (1937) produced a full account of the northern race. Recently Hanna and Wiley (unpubl.) worked on Red-shouldered Hawks in Ontario and Florida respectively.

From 12 pairs of *B. lineatus* known to be present within the 528 sq mi (1368 sq km) of Waterloo Municipal Region (formerly County), 6 were chosen for study. They were selected on the basis of accessibility of nests and proximity to each other. Each pair was visited six to eight times in optimum weather during the 1973 reproductive season. Ecological conditions—especially habitat, interspecific competition, general behavior, and reproductive suc-

cess—were recorded. Unfortunately, only two nest trees could be climbed safely. (Earlier data at the Royal Ontario Museum, Toronto, were also consulted.)

My study sites varied from 970 to 1230 ft (295 to 375 m) above sea level. The average elevation of the region is 1000 ft (305 m). The study areas were settled between 1806 and 1853. Three nearby cities had populations ranging between 62,000 and 149,000. All study sites were in heavily glaciated and dissected topography near streams and/or ponds. Four occupied nests were located on urban plots: a golf course and relict woodlots. The other two were in farm woodlots within the urban shadow; one of these was adjacent to a subdivision.

All territories studied were in woods of Alleghenian or Transitional affinity, with principal hardwoods being beech (*Fagus grandifolia*) and sugar maple (*Acer saccharum*). The southernmost woods contained a considerable percentage of oak (*Quercus* sp.); only one wood was devoid of eastern hemlock (*Tsuga canadensis*).

Red-shouldered Hawk breeding territories range up to one square mile (2.59 sq km) in extent (Craighead and Craighead, 1956). An area of about that size around each nest was examined and mapped. Vegetation in a 0.10 ac (0.0405 ha) circular plot centered on the nest tree was further quantified for main types of cover following the method of James and Shugart (1970).

Pair 1

Pair 1 utilized the most urban territory, which generally represented the minimal habitat requirements in the study region. Construction and both residential and industrial traffic surrounded this pair throughout 1973, sometimes as near as 30 ft (9.1 m)! Even tree-cutting (to clear land for houses) and bulldozing (which altered drainage into a pond) did not deter them. Many salamanders and frogs continued to spawn in the shrunken woodland pool. These and snakes were hunted. Competition with other raptors was slight or nil.

The nest tree was well within a 36 ac (14.6 ha) mature deciduous wood. Forty-four trees having a diameter of 3 in (7.5 cm) or more occurred in the 0.10 ac sample plot with a total basal area of 22.3 sq ft. Ground cover was 80 percent; canopy cover, 65 percent. The nest tree was a slender high-crowned ash (*Fraxinus* sp.) with a DBH of 15 to 20 in (38.0 to 50.0 cm) and a height of 70 ft (21.3 m). The rather flimsy nest was at a height of 55 ft (16.7 m).

Pair 2

Pair 2 utilized a more secluded, but still urban, area. Active and derelict farming, construction of a multiple-dwelling subdivision, and golfing occurred nearby. Estate homes on wooded lots were the closest habitation. Below the nest was a spring-fed stream and a swampy depression that had almost dried up.

Food on the manicured golf course hardly seemed sufficient for the single pair of Red-tailed Hawks (*Buteo jamaicensis*) and the Great Horned Owls (*Bubo virginianus*) that nested there. I found no amphibians or reptiles in the area.

The Red-shouldered Hawk nest was 40 ft (12.2 m) up in a 64 ft (19.5 m) beech of 15 to 20 in DBH. It was on a hemlock-hardwood ridge within a broken, 88 ac (35.6 ha) tract of mature woods. Twenty-four trees having a DBH of 3 in or more were found in the 0.10 ac plot. Their combined basal area was 14.4 sq ft. The woods were being thinned, but ground cover was still 65 percent and canopy cover 95 percent.

Pair 3

Although well within a recently annexed area and within 120 ft (36.5 m) of a major arterial road, this territory was well buffered. Derelict farmland and a large abandoned

millpond, along with extensive reforestation across the highway, flanked the relict conifer-hardwood bush of 10 ac (4.0 ha) within which the nest was placed. Beyond these buffers subdivisions were being built near the old community of Doon.

Small birds, rodents, and amphibians were moderately plentiful; swales and a permanent nonchannelized but polluted creek were nearby.

The nest was 40 ft high, in a 60 ft (18.2 m) beech of 30 in (75.0 cm) DBH—one of the largest trees on the tract. Within the sampled plot were 58 trees having a DBH of 3 in or more; their total basal area was 23.8 sq ft. Ground cover was only 15 percent; canopy cover was 85 percent.

Pairs 4 and 5

Pairs 4 and 5 were on the extreme edges of cities. Largely intact swamps with some suburbs encroaching upon them provided favorable hunting grounds, but some lumbering occurred at both sites. Water sources were permanent and of good quality. Nesting was in upland mature mixed woods along ridges overlooking wide expanses. Nests were within forests of 10-40 ac (4.0-16.2 ha), in 55 to 60 ft beeches having a DBH of 21 to 27 in (52.5-68.0 cm).

Hikers passed near one site, and cattle grazed at the other. Few direct contacts were observed with Red-tailed Hawks.

Pair 6

Except for a few suburban estates and long-established active farms, this territory was remote. It was outside the city limits. However, there was a new house nearby, and 237 ft (65.5 m) south was a well-traveled gravel road to a resort lake.

Streams in the valley north of the nest were in excellent condition. Until 1973-74, the heavy hemlock-beech forest here was virtually uncut. Small mammals and amphibians were plentiful, but interspecific competition was strong. Barred Owls (*Strix varia*) had been nesting in the same valley; a Sharp-shinned Hawk (*Accipiter striatus*) territory was to the north. Encounters took place with Red-tailed Hawks, Crows (*Corvus brachyrhynchos*), and another pair of Red-shouldered Hawks (no doubt Pair 5, which had its nest 0.5 m [0.8 km] south).

The nest was about 40 ft up in a 25 in (62.5 cm) DBH beech 58 ft (17.5 m) high. The tree stood in a mixed tract of 52 ac (21.1 ha). Trees 3 in and over within the 0.10 ac numbered 37; total basal area was 16.7 sq ft. Ground cover was 35 percent; canopy cover, virtually 100 percent.

Interspecific Competition

Interspecific encounters involving Red-shouldered Hawks were principally with Red-tailed Hawks and Crows. During the 1973 study, two encounters between nesting Red-tailed and Red-shouldered Hawks were noted. In one the single encroaching Red-tailed Hawk was driven off by the female Red-shouldered Hawk. In the other, a single Red-tailed Hawk appeared to pursue a pair of Red-shouldered Hawks. Crows harassed the young of Pairs 1 and 4 and the adults of Pair 3 while we were climbing to their nest. During the latter episode, the Crows seemed dominant through sheer numbers. Crows were also plentiful (perhaps because of nearby garbage) at the site of Pair 4. This pair's nest was also molested by gray squirrels (*Sciurus carolinensis*). The hawks may have moved from nest to nest as a result. Unfortunately no work could be carried out on the relationship between Red-shouldered Hawks and Great Horned Owls. However, during the spring of 1974 these owls occupied the nest of Pair 1 before it returned to the territory. Red-shouldered Hawks were not seen there that year. Owls had not nested within 1.2 mi (1.9 km) in 1972.

Food

No tethering of young below nests for food studies was practicable, we felt, because of the accessibility of the sites.

Despite 12.5 man-hours at each site during the breeding season, I saw only one food transfer between adults. The male of Pair 1 seemed to forage widely, perhaps because of marginal habitat conditions.

Several times Red-shouldered Hawks at study sites were observed perched near singing frogs. Pair 1 was seen to capture a garter snake (*Thamnophis sirtalis*) and a small rodent, which was fed to the young. Icterid or Starling (*Sturnus vulgaris*) bones were found in a pellet below the nest of Pair 3. These animals are known to comprise the main food of breeding Red-shouldered Hawks (Ernst 1945, and others).

Reproductive Performance

Pair 1 produced three young, the only pair of the four with complete data in 1973 to do so. At least two of this brood were fledged (one chick was small and weak, and its fate is unknown). This pair exhibited strong territoriality but were relatively tolerant. Red-shouldered Hawks had occupied this woodlot for at least four years and the same nest for three.

Pair 2 was not seen in the nesting woods after early April. Earlier they had lined a nest and vigorously protested intrusion. Human disturbance, food shortage, and/or successful nesting of Red-tailed Hawks and Great Horned Owls nearby may have caused their disappearance from this apparently new territory.

Pair 3 laid three eggs, one of which was taken for analysis. Two young were ready to fledge in late June. This strongly territorial pair was thought to have nested within a 0.5 mile (0.8 km) radius from at least 1967. Habitat was moderately good but not ideal (i.e., urban).

The outcomes of nestings by Pairs 4 and 5 were not definitely known. Pair 4 was well established but tolerant of disturbance; however, it made three disrupted nesting attempts in 1973. Presumably they finally reared two young, as reported by residents, within the same wooded suburb. Pair 5 was wary but stable; the nest was difficult to observe. Excrement and audible calls led me to believe that young may have hatched. Pair 6 deserted after its clutch of two eggs was taken on 7 May. The nest, apparently a new one and weakly defended, was lined with an abnormal amount of down. Eggs were small and scarcely pigmented. At least one bird remained in the area until August.

Thus, of six nestings studied during 1973 in the Waterloo Region, the outcomes of only four were known definitely. Two clutches of eggs were observed: one with three and one with two. An additional pair, Pair 7, was not studied in detail but was known to fledge one young. Thus from seven nestings, perhaps eight young were reared; seven of these probably fledged (1.0 young fledged per pair). Though my sample size is small, this recruitment rate is not high enough to maintain the population (Henny 1972).

Sixteen nesting records of *B. lineatus* in the Waterloo Region from 1958 to 1972 (Campbell and Royal Ontario Museum, unpublished) fledged an average of 1.7 young each. Ten broods from Royal Ontario Museum data between 1958 and 1961 averaged 2.2 young per brood, which matches other stable populations (Henny 1972). My records for six broods, 1968-72, indicate that the broods averaged only 1.5 young.

Analyses of Eggs

The three eggs collected showed an average decrease of 9.4 percent in shell weight and 11.8 percent in thickness index when compared with pre-1947 figures. Shell thickness averaged 0.311 mm.

Analyses by Ontario Research Foundation for the CWS of the three eggs revealed and following residues, wet weight, ppm: DDE 1.40-3.78; Dieldrin 0.08-0.42; DDD 0.17-0.29; DDT 0.06-0.29; heptachlor epoxide 0.03-0.08; hexachlorobenzene < 0.01; polychlorinated biphenyls 0.87-2.56. Mercury (wet weight) was 0.12-0.34 ppm. The small and poorly pigmented egg from the City of Kitchener (Pair 3) had the highest residue levels for all substances but mercury, which was higher in the rural clutch (two eggs of Pair 6). However, those two eggs, possibly from a young female or a renesting, were also small and poorly pigmented. Compared with three Maryland eggs similarly analyzed (Henny et al., 1973), our sample showed higher levels of all substances except hexachlorobenzene, mercury (not done), and polychlorinated biphenyls. The Maryland eggs came from an extensive, largely forested area.

Discussion and Conclusions

A marked decline has occurred in nesting *B. lineatus* within the study area since the early 1960s. Formerly it was the most common nesting diurnal raptor in the Region. For almost every square mile of favorable habitat, a pair could be found. I knew of six to seven pairs along an 8 mi (13.8 km) stretch of river valley near where Pairs 3 and 4 nested in 1973, and six to nine pairs within a radius of 3.5 mi (5.6 km) of where Pairs 5 and 6 nested in 1973. This decline has been commented upon in other Ontario localities (e.g., Goodwin and Rosche, 1974). A decrease of up to 10 percent (Henny, 1972) has also occurred in parts of the United States. This has also been noted for wintering Red-shouldered Hawks (Brown, 1971) in all States but California and West Virginia. The largest losses seem to be in the Northeast.

The "crash" in Red-shouldered Hawk numbers in Ontario has been dated by Hanna (1973 pers. comm.) and me as beginning about 1964-67. Whether it has continued or has been arrested since 1969 remains uncertain.

Various causes, possibly interrelated in many cases, have been suggested for this decline. One of the most often postulated is habitat change and replacement by the dominant, more xeric-adapted Red-tailed Hawk and Great Horned Owl. The Red-shouldered Hawk prefers fairly sizeable tracts of low, wet woodland, where it often hunts below the canopy. In Waterloo Region most remaining pairs are in river or creek valleys or in swampy bottomlands. Drainage for increased agriculture and urbanization, as well as for deforestation, in southern Ontario has sharply accelerated in recent years. These, a resultant decrease in reptiles and amphibians (important prey for Red-shouldered Hawks), and an increase in mammals favored by Red-tailed Hawks and Great Horned Owls, are undoubtedly important. Notably scarcer here in the breeding seasons before 1958, the Red-tailed Hawk has since reversed its position. Also, like the Great Horned Owl, it breeds earlier than *B. lineatus* and so appropriates its territory.

At Patuxent, Maryland, loss of habitat seems to be the vital factor in a decline of breeding Red-shouldered Hawks. A 9 percent decrease in shell thickness was found between pre-1947 and 1971 in a sample of 15 addled eggs, a value considered too low to impair recruitment (Henny et al., 1973). In Ontario also there has been loss of habitat, but much suitable habitat is now unoccupied. Egg breakage and addled eggs have been reported (Mason, 1971; Frank et al., in press). Eggshell thinning, in addition to the three eggs reported here, has been found in Ontario by Anderson and Hickey (1972), C. A. Campbell (MS report, 1974), and Frank et al. (in press). Values generally have been about the same or slightly higher than the

Patuxent figures but are still below the critical point. Present data, although too few to be definitive, suggest a need for further studies on the possible influence of pesticides on Red-shouldered Hawks in Ontario.

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